

The isospin dependence of the nuclear surface tension*

W.D. Myers and W.J. Świątecki

Using the Thomas-Fermi nuclear model we have constructed a standard dimensionless function γ that can be used to estimate the dependence of the surface tension $\gamma(\delta)$ on the relative neutron excess δ for a variety of models, using only the models' properties calculated for standard (semi-infinite) nuclear matter with $\delta = 0$. Thus

$$\gamma(\delta) = \gamma_0 \Gamma(\nu), \quad (1)$$

where $\nu = \delta^2/D$, $D = 4Qa_2/9J^2$, a_2 is the surface energy coefficient related to γ_0 by $a_2 = 4\pi r_0^2 \gamma_0$, r_0 is the nuclear radius constant, J is the symmetry energy coefficient and Q is the neutron skin stiffness coefficient. All the above quantities refer to standard semi-infinite nuclear matter with zero neutron excess. The standard function Γ is given by

$$\Gamma(\nu) = c_1(\sqrt{\nu^2 - c_2\nu + c_3^2} - \nu + c_4), \quad (2)$$

where $c_1 = 0.5467$, $c_2 = 1.7107$, $c_3 = 1.0316$, $c_4 = 0.7975$. Using eq. 1 we have calculated $\gamma(\delta)$ for the well tested Thomas-Fermi model of [2] for which $r_0 = 1.14$ fm, $a_2 = 18.63$ MeV, $J = 32.65$ MeV and $Q = 35.4$ MeV, leading to $\gamma_0 = 1.1408$ MeV/fm² and $D = 0.2750$. This should provide a good baseline estimate of the isospin dependence of the nuclear surface tension.

We have also cleared up a long-standing puzzle concerning the difference between Gibbs' definition of the surface tension and the surface tension used up to now in the droplet model, and we have derived the algebraically trivial, but physically far-reaching modification of the droplet model definition which brings it in line with that of Gibbs.

*Extracted from Ref. [3]

[1] W.D. Myers and W.J. Świątecki and C.S.Wang, Nucl. Phys. **A 438**, 185 (1985).

[2] W.D. Myers and W.J. Świątecki, Nucl. Phys. **A 601**, 141 (1996).

[3] W.D. Myers and W.J. Świątecki, "The isospin dependence of the nuclear surface tension", LBNL-46753, November 22, 2000, to appear in Phys. Rev. C.